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IMPACTS OF TRADE AND TECHNOLOGY ON COMPETITIVENESS: THE CASE OF HIGH OIL CORN

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Introduction

The traditional commodity grain marketing system is a complex network involving growers, grain handlers, brokers and processors. The marketing system consists of firms that compete as traders of homogeneous commodities, generating low margins per unit that require a high volume to earn a profit. The quality is based primarily on grading standards defined by United States Department of Agriculture (USDA). This grading system lacks adequate orientation towards end user's demand in today's rapidly evolving consumer food market. The concept of a product with specific features designed for a target end-user (consumer) is rapidly becoming the norm for today's consumer markets, rather than a homogenous commodity of one grade for all buyers.

Agricultural biotechnology and conventional plant breeding have delivered value-enhanced crops. For example, high oil corn (HOC), which is produced from plant breeding is directed at meeting the demand of end-users. HOC requires identity preservation, beginning with complete crop isolation in the field, through the harvest period and on-farm storage, to the grain elevator and subsequent shipment to the final destination. Nimble transportation and handling plays a major role in moving the raw product from the corn grower through the elevator system to the end user.

End users, primarily livestock farmers, have demonstrated a demand for HOC attributes. HOC contains 6 to 8 percent oil compared to an average of 3.5 percent oil for typical corn (Figure 1). The increased oil content results from a larger embryo that not only reduces the level of starch and low quality protein, but also improves the protein quality. Since fat contains about 2.25 times more energy than starch, this increases the energy content of the grain. HOC is developed from plant breeding for oil characteristics, through the blending of a male pollinator seed with a male sterile seed in the same bag. HOC is not a Genetically Modified Organism (GMO) product.

These HOC benefits contribute to nutritional replacement and milling efficiency. The amino acid availability is greater, thereby reducing the use of fat substitutes and allows lower value ingredients to fit into the ration to increase flexibility of feed formulation.

HOC production has increased rapidly throughout the past five years. In 1995, the first year of commercial production, 170,000 acres were planted in the U.S. The area increased substantially to 1.0 million acres in 1998, and the current estimate is that 2.0 million acres will be planted in 1999. Consumption of HOC has been primarily in livestock feed, especially for hogs, broilers, and other monogastric animals that benefit most from this corn. Dairy cattle and beef cattle also consume small amounts of HOC. The export market buys about 33 percent of HOC today and the domestic market buys the remaining 67 percent. Despite the rapid and early growth, the distribution of value and risks associated with production, marketing and distribution among growers, grain handlers, end-users, and biotechnology firms remain unclear.

Objectives

The focus of this paper is to discuss the principal strategic and managerial issues facing participants in the identity preserved supply chain of high oil corn, as the orientation toward end-users' demand becomes an increasingly large part of the food system. The paper analyzes the risks and returns for the grower, grain handler and an end-user (hog farmer) and examines the broader implications for trade, using as an example, the North American Free Trade Agreement (NAFTA).

The Commodity Corn Marketing System

The commodity corn marketing system involves a large number of corn producers, livestock farmers, elevators, brokers, and processors (Figure 2). The commodity system is based on a homogenous product oriented towards high volumes and low margins. Farmers have three general marketing alternatives for corn at harvest: (1) feed to on-farm livestock or sell to other farmers for feed; (2) sell the grain to the commercial market system; or (3) store the grain on farm or off farm for later sale. Grain firms play a major role in purchasing, collecting and storing corn from farmers for sale to feed and food processors, and for export.

Innovation in Agricultural Biotechnology and Information Technology

Breakthroughs in the understanding of biology at the molecular level will likely create waves of new technologies and products (Figure 3). HOC is expected to be the base on which many new quality traits (characteristics) can be added in the future. These may include crop protection traits, quality traits, agronomic enhancements, and industrial applications. Over the past four years, crops with herbicide tolerance and resistance to particular pests have been developed. Quality enhanced crops, such as corn with high oil or lysine content and soybeans with high oleic or sucrose content are being developed and marketed on a limited scale. Kalaitzandakes et al., (1998) suggests that bioengineering may enhance the economic value of crops through the production of bioplastics, enzymes and enhanced nutritional and pharmaceutical agents – nutraceuticals. Agracetus, a wholly owned subsidiary of Monsanto, has begun clinical trials with human antibodies purified from genetically engineered corn and soybeans for use as anti-cancer agents (Urban, 1998).

Technologies and products are expected to redefine the growth and value creation potential for agriculture, resulting in a wave of strategic corporate decisions. New companies and industries will emerge, and existing companies must redefine themselves in order to remain competitive and exploit new business opportunities. Companies and industries that fail to recognize the magnitude and potential impact of this developing technology wave are likely to lose market share and profitability. The number of agricultural biotechnology mergers, research and development agreements, joint ventures, licensing agreements, and distribution agreements has been large in the late 1980s and early 1990s (Table 1).

Success in commercialization of agricultural biotechnology will hinge on assets and expertise. The first group is the technology and delivery vehicle, which combines the development of a leading-edge biotechnology platform with a global state-of-the-art integrated seeds business, as well as vegetative propagation for non-seed based crops. The second group is the commercialization structure for the development of innovative new product systems and business structures to create and capture value generated from the farm gate all the way to the end-user (Shimoda, 1998).

Monsanto is a leader with massive investments in biotechnology research, and with seed and biotechnology company mergers and acquisitions. Novartis, DuPont and Pioneer, Dow Agrosciences, AgroEvo (Hoechst/ Schering), and Zeneca and Van der Have are all involved in similar efforts on a smaller scale (Hayenga, 1998). Many of these companies are also involved in major disputes over patent rights to insect resistant *Bacillus thuringiensis* (Bt) corn technology contracts, and gly-phosphate resistant corn technology; and in market foreclosure and monopolization issues in the herbicide market.

Risks and Returns for the High Oil Corn Grower

The individual grower must decide whether or not to grow HOC based on the risks and returns compared to growing Number 2 Yellow Corn, also known as regular corn (Table 2). Based on the assumptions of equal yields of 130 bu./acre and a $0.17 /bu. premium for 7 percent HOC, the return above variable costs is $137.66 per acre compared to $160.00 for regular corn, a difference of about $23.00. In this case the profitability of HOC does not compete with growing regular corn.

The key differences are the higher cost of the seed and the technology fee charged by the seed producers (Table 2). The higher recommended seeding rate for HOC increases the seed cost for the grower (Hahn and Schuerman, 1976). Plant breeders recommend a plant population of 30,000 seeds per acre for HOC or about 10 percent more than for regular corn. The higher rate is required to obtain comparable yields with normal corn because a male pollinator - that comprises about 8- 10 percent of the seed - produces small ears that would reduce yield per acre without the higher planting rate, and may be more susceptible to disease, insects, and weather damage.

Another important variable affecting the profitability is the oil content. At higher levels of oil such as 8.0 percent compared to 6.5 percent and a comparable yield of 160 bu./acre, HOC returns $206.58 above variable costs compared to $184.16 for the 6.5 percent oil corn (Table 3). The return is higher because the 8.0 percent oil earns a premium of $0.25/bu. compared to a premium of $0.11/bu. for 6.5 percent oil. Higher oil content equals a higher premium. Field study interviews indicate that the higher oil content is feasible with good management practices.

Added risks that affect the decision to grow HOC include production and marketing risks that require more skilled management practices. Crop rotation is more important for HOC than normal corn. HOC should not be planted after normal corn because of potential disease problems and volunteer corn that will lower oil content. HOC requires buffer areas of about 50 feet around the perimeter of the field to protect from possible pollination by normal corn in a nearby field. Cross-pollination would lower the oil content. HOC may also be less resistant to drought, insects, and disease that could reduce yields and oil content.

HOC requires isolation during harvesting and storage to preserve identity for the buyer. Producers need dedicated storage bins. Transportation, handling, and drying systems must be clean and free of contamination from other corn. If the corn moisture level is too high for storage, HOC drying costs may be higher because the higher oil content lengthens the drying time. Marketing contracts typically require on farm storage for two months or more, which increases drying and storage costs, but this may not be a problem for many producers who want to store corn anyway. However, some HOC contracts pay farmers a nominal amount for storage. HOC contracts typically state that delivery is on demand which may cause problems for producers if they must deliver at a very busy time of the year.

Producers may face the risk of premium changes for the same oil content from one year to the next and contract premiums vary among buyers within the same year. Field interviews indicate that premiums have been declining the last couple of years, reducing the return to the grower. In addition to the oil content risk, some HOC contracts contain minimum test weight requirements (e.g. 54 pounds/bu.) to earn the contract premium. Test weight is more variable for HOC than for normal corn.

Therefore, management practices and marketing strategies become key variables affecting the profitability of HOC corn. Field interviews conducted with farmers confirm that management is important and that HOC is profitable if timely practices are undertaken.

Risks and Returns for the Grain Handlers

The grain handling system will require major adaptation to handle HOC and other niche market products as they appear in the market place. Increased coordination and management among growers, handlers, and end-users is necessary. Increased investment in new facilities and equipment will be required to handle specialty products. Expensive testing equipment (near-infrared spectroscopy, NIRS), which costs about $25,000, is required to measure oil content and other qualities of HOC; and it will also be essential for other new products.

The current grain marketing system is not structured for identity preserved grain. Rather, the system is structured to handle, store, and ship large quantities of a homogenous commodity at low margins to sell at competitive price to buyers around the world. The current system has a small number of large bins, uses large ships, and large trains. Identity preservation requires the opposite. A larger number of smaller storage bins, smaller ships, or compartments of ships, and smaller unit trains and/or dedicated railcars will be needed for niche markets. Co-mingling and blending of grain, a major profit activity for grain handlers, is not part of this niche marketing system.

Risks and Returns for the End User

Research indicates that HOC pays the highest return to the hog and broiler user and other monogastric animals, and somewhat lower returns to the dairy and beef user. The major benefits are more energy, higher quality protein, and higher returns to the hog and broiler user. Since HOC substitutes for fat in the hog ration, the higher the oil content, the less fat that is required for the hog ration (Table 4). The hog producers' break-even premium varies from $0.20/bu. at 5.0 percent oil to $0.36/bu. at 7.5 percent oil (Table 4). The price of fat (e.g., used fast food cooking oil and animal fat) sets the upper limit on the break-even premium for HOC. As fat becomes cheaper in the market place, the value of HOC in the hog ration will decline because cheaper sources of energy become available.

Risks and Returns for the Agricultural Biotechnology Firm

Many risks face the biotechnology firm developing HOC and other new products. Profitability is, of course, a key matter for all players in the system. The new products must not only be profitable for the biotechnology firm but also for all other players in the system. There must be distribution of value for all players if the new products are to succeed in the market place. Corn growers, grain handlers, end-users, and the biotechnology firms must all profit if HOC is to succeed. At the present time HOC appears to be marginally profitable to the end-user, so there is not a lot of value to distribute throughout the grain marketing system. For HOC to be a success, the profitability may have to reach the levels that were obtained when hybrid corn was introduced to the market. Depending on the amount of risk, profitability must reach the 20 percent level or higher for producers to be willing to adopt new technology (Meyer and Larson, 1997). If profitability is high, growers will adopt rapidly the new technology.

A rapidly changing competitive environment resulting from mergers, consolidations, and strategic alliances among biotechnology firms, chemical companies, seed companies, grain companies, and pharmaceutical companies indicates that many firms want to re-structure their businesses to gain a competitive advantage and profits in the biotechnology market. The investment cost to bring these new products to market is very high and so is the risk of failure. Most products (about 90 percent) fail to become commercial successes.

Firms also face many challenges to protect intellectual property rights. Patent violations are becoming more common as firms strive to gain a competitive edge in the market place. Protection of intellectual property rights is basic to the biotechnology firms' willingness to invest huge sums of capital in research to develop and market new products. As new technology spreads globally, patent protection becomes even more important because the markets become even larger, and at the same time, more difficult to enforce because of different laws and regulations among countries.

World acceptance of biotechnology food products will likely become an increasingly large issue facing the entire industry. Consumers, producers, governments, and advocacy groups have different views about biotechnology food products. Consumer groups want more accurate content labeling of products and the ability to trace the origin of products. While HOC is not a GMO, many GMOs sold commercially are not accepted in some markets. Major corn processors and exporters (e.g. ADM, Cargill, and Staley) announced in April 1999 that they will not accept GMO corn hybrids until approved by the EU (Hillyer, 1999). The buyers must take this precaution to protect their export markets. Farmers in India who adopted the Green Revolution technology very rapidly burned their "Bt" cotton fields recently because of fear that the cotton contained a terminator gene. These issues of market acceptance and patent protection are a concern to suppliers and users in the NAFTA countries -Canada, United States, and Mexico.

Despite these problems, the profit potential is large. For example, high oil corn may be just the tip of the iceberg in terms of the future market potential of a biotechnology product (Figure 4). Each new trait in the pyramid is expected to add value to the product. As more value is added from new traits, HOC may change from a product that is marginally profitable today to one that is far more profitable tomorrow. For example, HOC plus high lysine, plus high methionine is estimated to add \$95 to \$100 per acre (Kalaitzandonakes and Maltsbarger, 1998). As the profits increase, the success of HOC will likely depend on the distribution of value to all players.

Environmental Impact

High oil corn has some favorable impacts on the environment. HOC in animal feed improves feed mill throughput (consistency of mix) in the grinding process, thereby using less energy to grind and also reduces dust in the feed mill. Feed manufacturers have experienced a reduction up to 12% energy (amps) during rolling HOC. In the rolling process dust has also been reduced. Future benefits will include low phytate corn that increases digestible phosphorus by animals, thereby reducing phosphorus content in animal waste and runoff into rivers and lakes.

Competitiveness through NAFTA

U.S. agricultural exports to Mexico have increased rapidly from \$2.5 billion in 1990 to \$6.1 billion in 1998 (Table 5). Mexico's rapidly growing population has increased food demand and their increasing income per capita has changed the dietary habits of consumers to more value added protein products. As a result coarse grain exports, have increased significantly from \$757.5 million in 1990 to \$964.0 million in

1998. There has also been a substantial increase in the export of protein products such as meat, milk and eggs between 1990 and 1998. Poultry meat exports increased from $57 million in 1990 to $231.1 million in 1998 (Table 5). Mexican livestock producers have also demanded more protein ingredients for livestock feed; leading to a rapid growth in soybean exports from $201.4 million in 1990 to $754.2 million in 1998.

As the Mexican economy continues to strengthen from its 1994 recession, consumption of protein products is expected to increase. Climatic conditions in Mexico are not ideal for the production of corn, therefore, opportunities for an increase in the export of HOC as a major ingredient of animal feed is expected to grow; as are HOC exports to Canada for livestock feed. At the same, increased HOC usage in animal feed in the United States; resulting in more meat exports will likely grow.

Conclusions and Implications

HOC and other emerging specialty products will require more market integration and coordination among all players of the grain marketing system to succeed in the new product oriented consumer market place. Agricultural biotechnology firms, seed dealers, growers, handlers, and end-users must become more closely coordinated in many of their activities to satisfy the new customers' demands for value added products. HOC growers will face higher production and marketing risks than for typical corn. In return for the higher risks, they will want higher prices for HOC. Premiums currently being offered to HOC growers may not be adequate to assure a continued supply of HOC to the market.

Grain handlers face new investments in plant and equipment to handle the specialty products such as HOC. As producer and end-user contracts become more specific for these new products, more management time and improved management will be needed. Handlers will also want higher margins to pays for their added costs.

HOC increases value to end-users, primarily the hog and poultry producers. The estimated HOC value to a hog producer ranges from about $0.20/bu for 5.0 percent oil to about $0.36/bu. for 7.5 percent oil. The price of fat (an energy substitute for HOC in a ration) effectively sets an upper limit on the value of HOC to the livestock user. The amount of increased value to the end-user may not be enough to compensate all players for the added risks and costs. The economic success for all players will likely require the stacking of new traits on HOC to gain added profits. The future success of HOC and other value-added traits depends on value being distributed to all players.

Agricultural biotechnology firms face increased competition in the seed technology business. Many firms have re-organized, merged, sold off businesses, and acquired new businesses in an attempt to gain a competitive edge in this rapidly changing market. The competition is keen because the estimated sales and profits are large. Protection of intellectual property rights is the incentive that attracts firms to make the large investments that may lead to the larger profits. Without this protection in domestic and world markets, firms will not make large investments.

Consumer and producer acceptance of biotechnology products in domestic and world markets continues to be a major issue. Canada and Mexico, our NAFTA trading partners, will be addressing these concerns. Consumers, producers, and others question the safety of the new products to our food system. Already some types of GMO corn cannot be sold to the EU market. The WTO and NAFTA will be important trade organizations to assist consumers and producers in deciding what products will be traded on world markets and how intellectual property rights will be protected.

REFERENCES

Erickson, Paul A. (February, 1999) "Growing Food for the Future," Optimum Quality Grains, Paper presented at the Ohio Agribusiness Exposition, Columbus, Ohio.

Hahn, David E., and W.S. Schuerman (November-December 1976). "Seed Corn Purchasing Behavior of Ohio Corn Growers," *Ohio Report*, Vol. 61, No. 6.

Hayenga, Marvin. (1998). "Structural Change in the Biotech Seed and Chemical Industrial Complex." *Agbioforum*, 1 (2), 43-55. Retrieved January 1, 1999 from the World Wide Web http://agbioforum.missouri.edu.

Hillyer,Greg. (April 1999) "Know Before You Grow" *Progressive Farmer*. Web Page.

Hord Livestock Inc. (1999). Field visits in Crawford County, Ohio.

Kalaitzandonakes, Nicholas. (1998). "Biotechnology and the Restructuring of the Agricultural Supply Chain." *AgBioForum*, 1 (2), 40-42. Retrieved January 1, 1999 from the World Wide Web: http://agbioforum.missouri.edu.

Kalaitzandonakes, Nicholas and Richard Maltsbarger. (1998). "Biotechnology and Identity-Preserved Supply Chains – A Look at the Future of Crop Production and Marketing." *Choices*. Fourth Quarter, 15-18.

Kalaitzandonakes, Nicholas, and Bruce Bjornson. "Vertical Horizontal Coordination in the Agro-biotechnology Industry: Evidence and Implications." *Journal of Agricultural and Applied Economics*. 29 (July 1997): 129-139.

Kohls, Richard L. and Uhl, Joseph N. (1998) *Marketing of Agricultural Products*. 8th ed. New York: Macmillan.

Meyer, R.L. and Donald W. Larson, "Issues in Providing Agricultural Services in Developing Countries," Chapter Five in *Strategies to Promote Third World Agricultural Development and Food Security*, Luther G. Tweeten and Donald W. McClelland (edts.) West Port, CT: Praeger Publishers, December, 1997. Pp. 119-152.

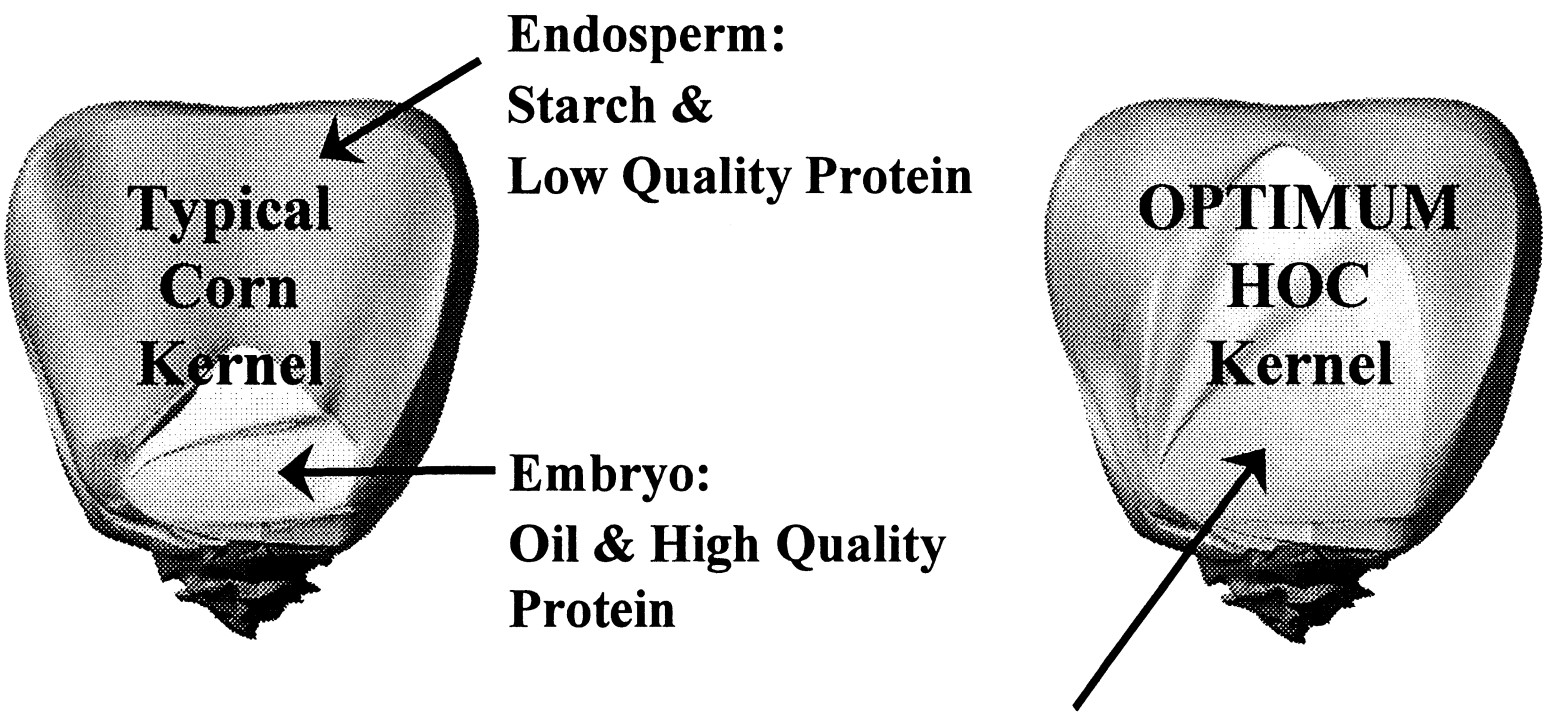
Renkoski, Matthew A. "Marketing Strategies of Biotechnology Firms: Implications for U.S. Agriculture." Journal of Agricultural and Applied Economics, 29, 1 (July 1997): 123-128.

Shimoda, Sano. (1998). "Agbiotechnology: Master of the Universe?" *AgBioForum*, 1 (2), 62 - 68. Retrieved January 1, 1999 from the World Wide Web: http://agbioforum.missouri.edu.

Urban N. Thomas. "Beyond Industrialization: The Prescription Food System." *Choices*. Fourth Quarter 1998: 43-44.

U.S. Department of Agriculture. (1999) Foreign Agriculture Service, Trade Statistics Web page.

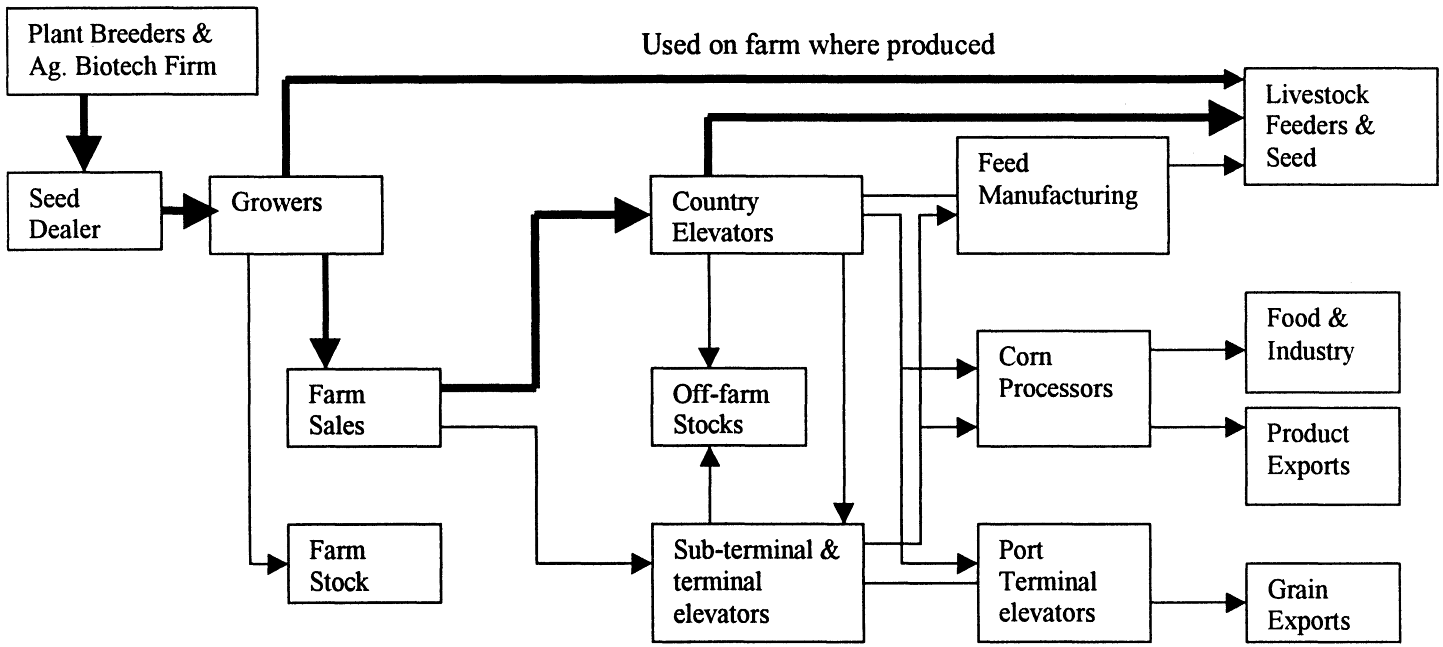
Figure 1: Typical Corn vs Optimum® High Oil Corn



Larger Germ in High Oil result in:

- Increased Oil Content
- Improved Protein Quality

Figure 2: Traditional and High Oil Corn Marketing System



Legend:
High Oil Corn Marketing
Traditional Corn Marketing

Sources: Kohls and Uhl, 1998 and Field Visits

Figure 3: The Future of Value-Added Grains

Market Potential Estimates ($ Billions)

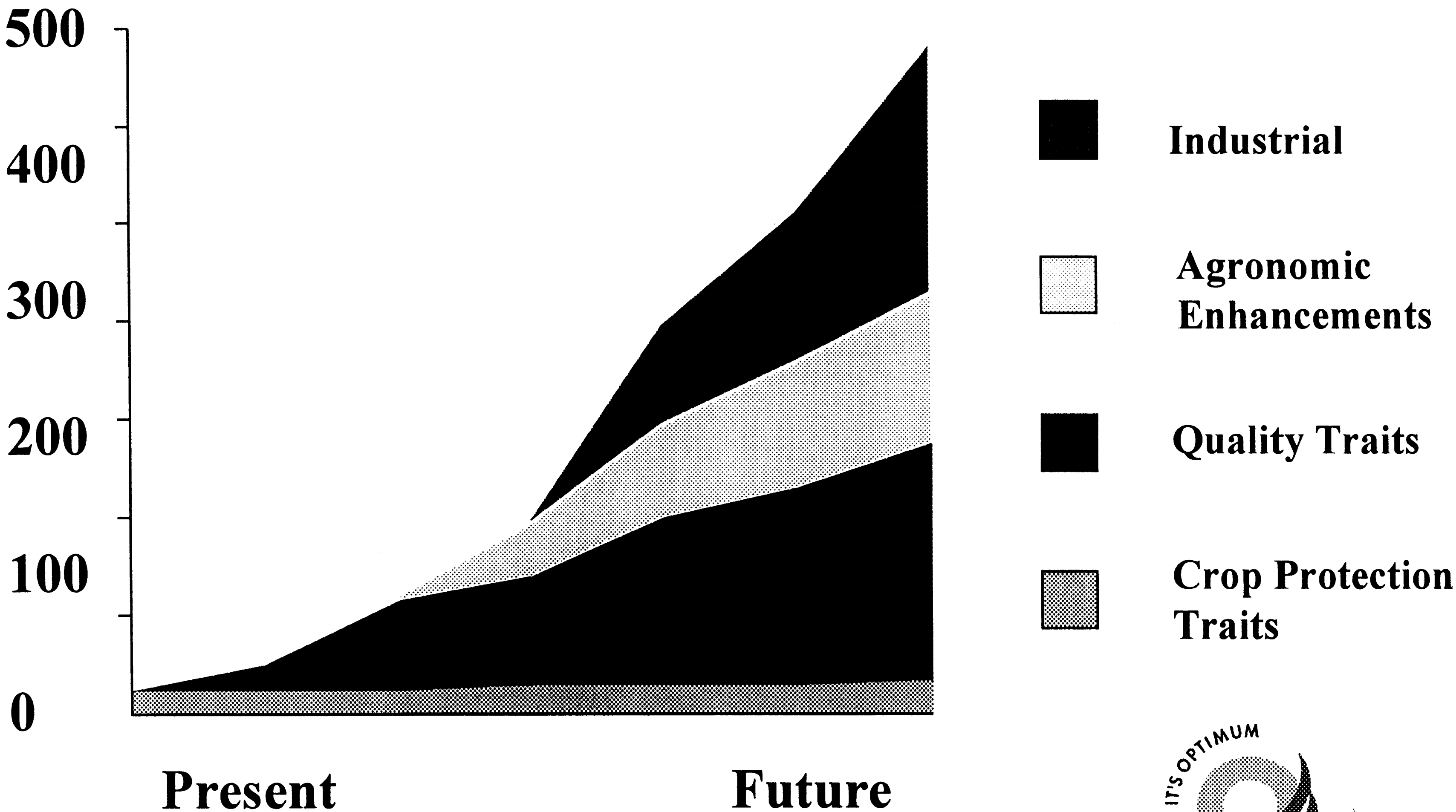


Figure 4: High Oil Corn is Just the Beginning

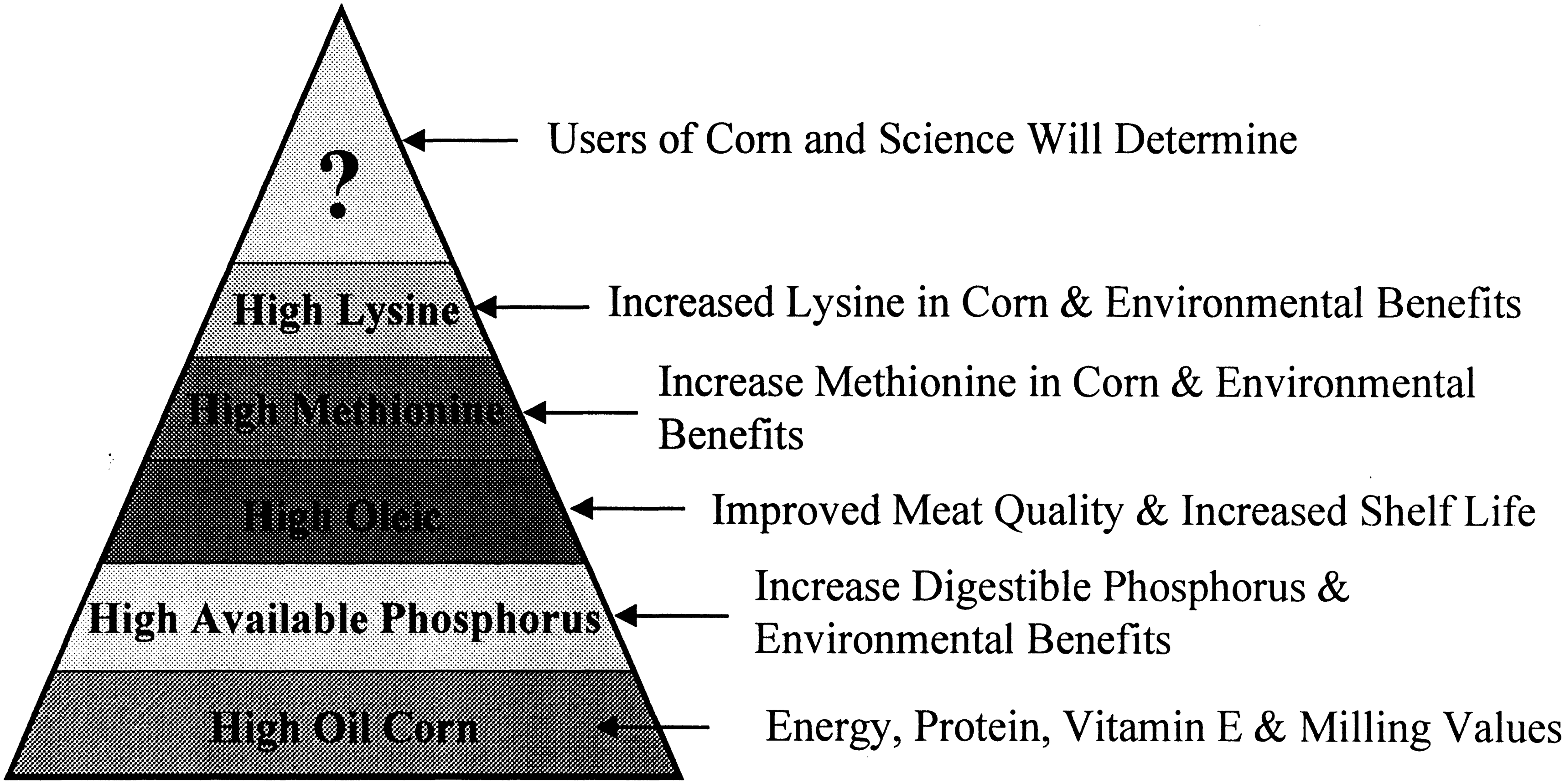


Table 1: Number of Inter-firm Activities in the Agricultural Biotechnology Industry

Activity	1981-85	1986-90	1991-96	Total 1981-96
Mergers & Acquisitions	19	115	274	408
Equity Investment	24	41	47	112
R&D Agreements	84	244	147	475
Joint Ventures	24	77	81	182
Licensing Agreements	6	78	122	206
Distribution Agreements	9	66	109	184
Production Agreements	1	3	21	25
TOTAL	167	624	801	1592

Source: Kalaitzandonakes and Bjornson. 1997

Table 2: High Oil Corn versus Number 2 Yellow Corn: Returns Per Acre

Key Parameters:	High Oil Corn	Number 2 Yellow Corn
Acres	1.0	1.0
Yield Per Acre (bushels)	130	130
Spot Price (Per bushel)	$2.50	$2.50
Premium (Per bushel)	$0.17	0
Oil Content	7.0%	3.5%
Income:		
- Revenue	347.10	325.00
Incremental Expenses:		
- Technology Fee ($30/unit)	11.11	-
- Seed Cost ($90.00/unit; 1 unit - 2.7 acres)	33.33	-
- Traditional Variable Costs	165.00	165.00
Returns Above Variable Cost	137.66	160.00

Source: Primary Data, Field Research

Table 3: High Oil Corn's Return Per Acre at Different Oil Levels

	High Oil Corn	High Oil Corn
Key Parameters:		
Acres	1.0	1.0
Yield Per Acre (bushels)	160	160
Spot Price (Per bushel)	$2.50	$2.50
Premium (Per bushel)	$0.11	$0.25
Oil Content	6.5%	8.0%
Income:		
- Revenue	417.60	440.00
Incremental Expenses:		
- Technology Fee ($30/unit)	11.11	11.11
- Seed Cost ($90.00/unit; 1 unit - 2.7 acres)	33.33	33.33
- Traditional Variable Costs	189.00	189.00
Returns Above Variable Cost	184.16	206.58

Source: Primary Data, Field Research

Table 4: Hog Producer's Break-even Premium
High Oil Corn (HOC) and Normal Oil Corn (NOC)

Oil Content	HOC (lb)	NOC (lb)	Fat (lb)	SBOM (lb)	NOC Equiv. Cost per 100 lbs.	Value of a bushel of HOC	Break-even Premium
5.0%	100	96.0	2.0	2.0	$4.82	$2.70	$0.20
5.5%	100	95.5	2.5	2.0	$4.88	$2.73	$0.23
6.0%	100	95.0	3.0	2.0	$4.94	$2.76	$0.26
6.5%	100	94.5	3.5	2.0	$4.99	$2.80	$0.30
7.0%	100	94.0	4.0	2.0	$5.05	$2.83	$0.33
7.5%	100	93.5	4.5	2.0	$5.11	$2.86	$0.36

Key Parameters:
Price of Normal Oil Corn (NOC) = $2.50 per bushel of 56 lbs.
Price of Fat = $0.16 per pound
Price of Soybean Meal (SBOM) = $215.00 per ton
NOC equivalent cost per 100 lbs. = sum of (NOC lbs.*2.50/56) + (Fat lbs.*0.16) + (SBOM lbs.*215/2000)
NOC equivalent cost times 56/100 = Value of HOC bushel

Source: Hord's Livestock Co. Inc.

Table 5: U.S. Exports of Agricultural Products to Mexico, Selected Years

Product:	1990	1994	1998
	(Millions of Dollars)		
Bulk Agricultural			
-Wheat	51.1	91.6	214.2
-Coarse Grains	757.5	749.4	964.0
-Soybeans	201.4	533.4	754.2
Intermediate			
-Feeds and Fodders	54.6	122.3	119.1
Consumer Oriented			
-Red Meats, Fresh/Chilled/Frozen	196.8	426.6	607.7
-Red Meats, Prepared/Preserved	15.9	65.3	43.0
-Poultry Meat	57.0	228.8	231.1
-Dairy Products	59.0	177.0	180.5
-Eggs & Products	8.8	17.9	44.5
Other Ag. Products	1,207.9	2,162.1	2,993.7
Total Agricultural Exports	2,553.0	4,574.4	6,152.0

Source: U.S. Dept. of Agriculture